STATEMENT TESTIMONY OF

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Mr. Chairman, distinguished members of the Subcommittee, thank you for the opportunity to appear before you today to describe the Department of Defense Science and Technology (S&T) program. I am honored to represent the great accomplishments of the thousands of dedicated professionals who work in the DoD S&T enterprise. Once again, this is an exciting year to discuss the merits and promise of the DoD S&T program—a program that has a long history of developing technologies that led to the superior operational capabilities employed and enjoyed by the men and women of our armed forces today. While the S&T program continues to deliver superior capabilities, the challenges we face in the future drive us to evolve and expand this program.

INTRODUCTION

The evolution of the national security threat, as outlined in the 2006 Quadrennial Defense Review, coupled with the emergence of an agile and global technology development base has led to a changing of the technology landscape for the DoD. When this is coupled with the emergence of a commercial technology base that paces military applications in some key areas, the result is an emerging set of challenges for the Department's S&T program. Over the past several years, Congress has recognized this evolving set of challenges, and consistently supported the DoD S&T budget requests. For that, we thank you. In response to the evolving need, the Department has experienced a decade-long growth in the budget request for the S&T program, culminating in this year's budget request of $11.5 billion dollars—a figure that represents a 4% real growth compared to the FY 2008 President's Budget Request. Of note, the FY 2009 budget request is also one of the highest S&T budget requests, in constant year dollars, since the inception of the McNamara budget process of the early 1960's. In fact, the seven highest DoD S&T budget requests have come in the past seven years.

Perhaps more noteworthy in this year's budget request is the increase in Basic Research. In the FY 2009 budget request, Basic Research grows to $1.7 billion; which is a 16% increase compared to FY 2008. This increase in Basic Research will be more fully discussed later, but the growth of both S&T and Basic Research are indicative of the continued commitment the Department is making to developing the technologies and capabilities to support the future operational needs of the men and women in uniform. Over the past several years, we have begun to reshape the S&T investment of the DoD to increase "non-kinetic[2]"

[2] The term "non-kinetic" was used in the 2006 Quadrennial Defense Review to describe those capabilities that do not have mass. For instance, non-kinetic capabilities include information and data, decision making, human-system interface, biometrics technology and so forth. "Kinetic" capabilities on the other hand, are platforms (ships, tanks, planes and weapons).

capabilities, and we are starting to see some real payoff in terms of capabilities being delivered to our warfighters. In addition, the fact that Congress has also given us flexibility in several programs to develop and apply technologies rapidly has allowed the DoD to field advancing non-kinetic capabilities more quickly. For example, one of the projects from the Quick Reaction Special Program led to an expanded role of the S&T community in defense biometrics and forensics.

While the DoD S&T program is currently well positioned to support the future force, there is still much to accomplish. The DoD S&T program must simultaneously develop technologies to improve conventional warfighting systems while addressing emerging technologies developed both in the DoD laboratories and commercially, and integrating these emerging technologies into a potential solution that provides greater capability to our forces. As an example, this trend is apparent in the mission area of persistent surveillance, where the amount of data available from sensors and information systems is growing from terabytes to exabytes and zettabytes in the near future. This "explosion" of information available to the warfighter is one prime area that needs the integration of technology developed in both the Department and commercially to support the warfighter. Simply, the ability to handle very large data sets in the future will be a challenge for the DoD.

THE NEED FOR DEFENSE SCIENCE AND TECHNOLOGY

Both the President and Secretary of Defense have recently highlighted the need to enhance science and technology, particularly in the physical sciences. For instance, in highlighting the American Competitiveness Initiative[3] the 2008 State of the Union address, President George W. Bush said:

> *"To keep America competitive into the future, we must trust in the skill of our scientists and engineers and empower them to pursue the breakthroughs of tomorrow… I ask Congress to double federal support for critical basic research in the physical sciences and ensure America remains the most dynamic nation on Earth.."*

Similarly, in February 2008, during his budget posture hearing, the Secretary of Defense Robert Gates said:

> *"As changes in this century's threat environment create strategic challenges – irregular warfare, weapons of mass destruction, disruptive technologies – this request places greater emphasis on*

[3] The American Competitive Initiative agencies are the National Science Foundation, National Institute of Science and Technology, and Department of Energy

basic research, which in recent years has not kept pace with other parts of the budget."

It is important to address reasons why both the President and Secretary highlighted science and technology and in particular, basic research, as key to the future. Simply, the globalization and application of technology provides more opportunities and challenges to the United States and subsequently to the DoD. In a recent essay written by Dr. Norman R. Augustine for the National Academy of Sciences entitled "Is America Falling off the Flat Earth?", Dr. Augustine cites a number of indicators highlighting the overall decline in the science and engineering posture of the United States. Among the indicators Dr. Augustine cites are:

- In 2004, Federal Funding of research in the physical sciences as a fraction of GDP was 54% less than in 1970. In engineering, it was 51% less. This decline in overall federal funding is amplified in the DoD, since the percentage of overall federal funding of basic research from the DoD has declined almost 8% over the same period.

- By the end of 2007, China and India will account for 31% of the global R&D staff, up from 19% as recently as 2004.

- The share of US post-doctoral scientists and engineers who are temporary residents has grown from 37% to 59% in two decades.

These are just several examples of the indicators of the decline in S&T, but they support an increase to the funding request for basic research in the Department's FY 2009 budget request. But these indicators, by themselves, do not constitute a need to increase DoD S&T funding.

Challenges facing the DoD have several additional complicating dimensions, some of which should affect S&T investment. As the United States continues to evolve in the Global War on Terror, the Department needs to develop an increased set of capabilities in disciplines not normally associated with the DoD. This need was highlighted in the 2006 Quadrennial Defense Review (QDR), a document that formed the foundation of the 2007 Department of Defense Research and Engineering Strategic Plan. The DoD has expanded our S&T investment in such areas as: Biometrics; Human, Social, Culture and Behavior Modeling; Locating, Tagging and Tracking; Networks; Persistent Surveillance; Cyber Protection, and other "non-traditional" areas. While there are a number of expanded mission areas the Department's S&T program should address, it is important to note the need to also conduct research to improve conventional weapons has not gone away, so a prudent mixture is needed.

Another aspect of the S&T program that is significant when considering funding is the expanded role of the DoD technologist to impact acquisition programs. This role is articulated in the new vision provided by the Under Secretary of Defense for Acquisition, Technology and Logistics. This vision is to "Drive Capability to Defeat Any Adversary on Any Battlefield." The key word for the S&T community is "drive." To drive the capability, the acquisition team, which includes S&T members, has to strive for agility and a sense of urgency. As part of this journey, the S&T team has expanded contact with the acquisition community through the use of technology readiness assessments—a process that allows the Department to insert matured technology into acquisition programs at the right time to minimize risk. By more closely managing technology maturity, the DoD should be able to accelerate fielding of systems. Additionally, we have revamped the cross-departmental planning process called "Reliance 21" and expanded our outreach to develop new scientists and engineers to work on DoD challenges. All of these tasks expand the requirements on the S&T program, and provide additional rationale to enhance S&T investment.

Thus, there is a situation where there is increased competition in the generation of new ideas and capabilities to the DoD, while at the same time the DoD S&T workforce is, of necessity, investigating a broader range of technical areas and simultaneously increasing the interaction with the acquisition and operational communities. This convergence of factors supports an increase in the President's Budget Request for S&T.

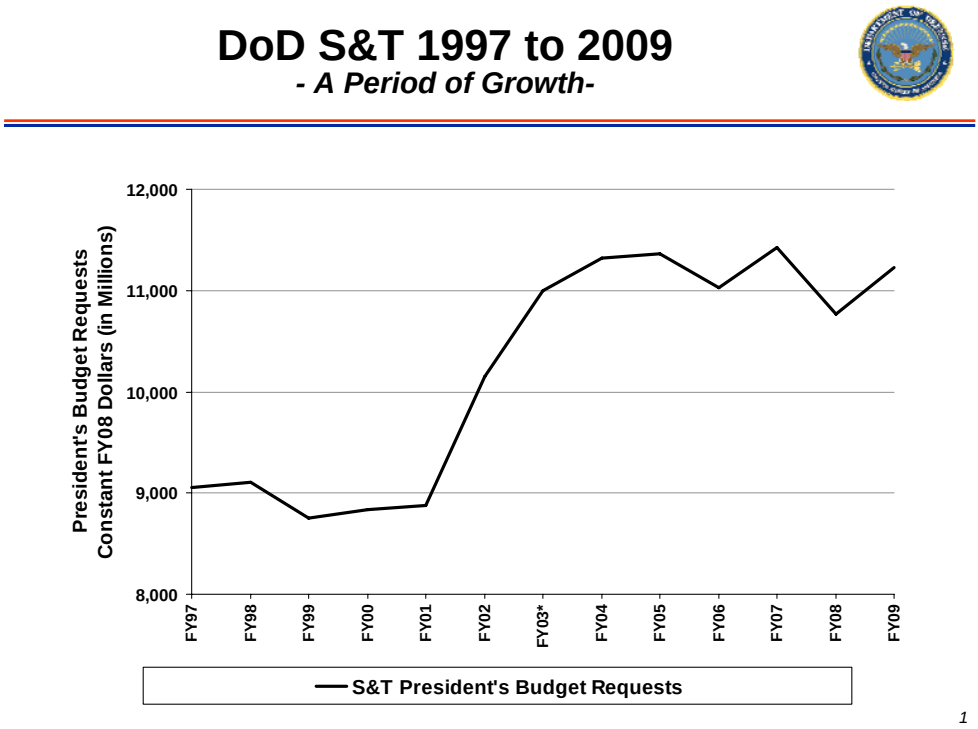
FY 2009 SCIENCE AND TECHNOLOGY BUDGET REQUEST – COMPONENT HIGHLIGHTS

As mentioned previously, the FY 2009 President's Budget Request of $11.5 billion represents a strong corporate commitment to investment in S&T, despite difficult budgetary demands from the Global War on Terror and growing non-discretionary departmental bills. The FY 2009 request is over four percent higher than the FY 2008 request, in real terms. From FY 2002 to 2008 the S&T budget has grown 10.6% (in real terms), or nearly two percent real growth per year. Figure 1 shows the President Budget Request, in constant dollars from 1997 to 2009 – clearly the DoD has been increasing emphasis on S&T.

Comparison of DoD Research and Engineering Requests

(President's Budget – Total Obligation Authority)

Then Year Dollars (in millions)	FY 2008 Request	FY 2009 Request
Basic Research	1,428	1,699
Applied Research	4,357	4,245
Advanced Technology Development	4,987	5,532
Total DoD Science and Technology	**10,772**	**11,475**
Advanced Component Development and Prototypes	15,662	15,774
Total DoD Research and Engineering	**26,434**	**27,249**



In FY 2009, the Department made a conscious decision to increase investment in the Services relative to the Agencies and Office of the Secretary of Defense. Consequently in this year's budget request, the Services once again account for more than half of our total S&T investment. Over the next several paragraphs, we will highlight the more significant aspects to the FY 2009 budget request across the DoD.

Army S&T Request

(President's Budget – Total Obligation Authority)

Then Year Dollars (in millions)	FY 2008 Request	FY 2009 Request
Basic Research	306	379
Applied Research	686	724
Advanced Technology Development	736	739
Total Army Science and Technology	**1,728**	**1,842**

The Army's Science and Technology (S&T) investments are shaped to pursue technologies that will enable the future force while simultaneously seizing opportunities to enhance the current force. The S&T program retains flexibility to be responsive to unforeseen needs. Major elements of the Army's FY 2009 S&T budget include:

- Basic Research ($379 million), the largest S&T investment, to fund advances in scientific knowledge with dramatic potential for the Army to achieve superior land warfighting capabilities. Army basic research continues to pursue network science, neuroscience, biotechnology, immersive technology, quantum information science, nanotechnology, and autonomous systems. The Army has also increased funding to establish research initiatives in human, social, cultural, and behavioral modeling; modeling and analysis of complex, multi-scale networks; and neuro-ergonomics.

- Force Protection technologies ($370 million) focused on providing active and passive protection to increase survivability of Soldier, rotorcraft, and ground vehicles. This includes the technology to defeat rockets, artillery rounds and mortars; detect and neutralize improvised explosive devices (IEDs)/mines; and protect against traditional threats to tactical and combat vehicles. Force protection technology continues to focus on protection technology suites that maximize protection through the synergy of effects such as increased performance armor, directed energy weapons, and electronic warfare technologies. Increased funding is provided for initiatives in advanced armor and materials to provide reactive and electromagnetic armor solutions against emerging and future kinetic energy and chemical energy threats.

- Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) technologies ($294 million) to enable networked surveillance and knowledge systems for

collaborative real time mission planning, on-the-move operations and networked lethality. These technologies include secure, mobile, ad-hoc networks for sustained high tempo full spectrum operations; infrared (IR) technologies for extended range threat detection and identification; and airborne imaging/moving target detection radars. This request also includes an increase in FY 2009 and 2010 to complete and transition the successful foliage penetration (FOPEN) Advanced Concept Technology Demonstration (ACTD) in support of USSOUTHCOM.

– Lethality technologies ($161 million) including development of next generation explosives and reactive materials to enable controlled lethality warheads to provide scalable effects that range from less-than-lethal to extremely lethal in a single munition; novel recoil attenuation techniques for large caliber weapons systems that reduce gun weight and improve performance; next generation seekers and warheads for affordable missile and gun systems such as the Non-Line-of-Sight Launch System; and electromagnetic gun research.

– Medical technologies ($140 million) that improve protection, treatment and life-saving interventions for Soldiers. The medical technology efforts focus on three major areas: combat casualty care (including the mitigation and treatment of blast injury and tissue regeneration efforts); infectious disease (diagnosis, treatment and preventatives), and operational medicine (the development of treatments and practices for Soldiers in extreme environments such as high altitude or sleep deprivation.)

– Soldier System technologies ($135 million) including advanced body armor, disposable and rechargeable electric power, Soldier-level networked communications and situational awareness, the development of techniques for selecting effective leaders and strategies for Soldier retention.

– Logistics technologies ($92 million) including precision airdrop; system prognostics and diagnostics for operational readiness; and hybrid electric drive train technologies to reduce logistics demand.

– Rotorcraft technologies ($72 million) that focus on achieving improved rotorcraft performance, increased operational readiness and lower operations and sustainment costs.

– Air and Ground Unmanned Systems technologies ($54 million) to reduce risks to Soldiers by extending reach and endurance through near autonomous capabilities for unmanned systems.

– Advanced Simulation ($37 million) for immersive mission rehearsal and advanced technology emulation and adaptive learning capabilities.

Navy (DoN) S&T Request
(President's Budget – Total Obligation Authority)

Then Year Dollars (in millions)	FY 2008 Request	FY 2009 Request
Basic Research	467	528
Applied Research	678	633
Advanced Technology Development	522	679
Total DON Science and Technology	**1,667**	**1,840**

The Department of the Navy (DON) has defined 13 Naval S&T focus areas. Within these areas are the traditional fleet technologies, but the Navy has also established focus areas in power and energy, maritime domain awareness (surveillance coupled with information processing), and assured access to hold an adversary at risk. Major elements of the Navy's FY 2009 S&T budget request include:

– Discovery and Invention (D&I) ($773 million) consists of basic research and the early stages of applied research. D&I is the seed corn for future naval technologies and systems. It provides technology options, maintains critical U.S. S&T capacity, and develops the next generation of the S&T workforce. The D&I portfolio, by design, has a broad focus, and programs are selected based on Naval relevance and technology opportunity. An important aspect of the Office of Naval Research's (ONR) D&I is the investment in unique Naval disciplines (e.g., ocean acoustics, underwater weapons, underwater medicine, naval engineering), and those areas that could benefit expeditionary warfare. To avoid sub-critical DON investment, D&I investments leverage other Service, governmental department, industry, international, and general research community investments.

– Acquisition Enablers ($589 million) center on Future Naval Capabilities (FNCs). These work to mature technology into requirements-driven, transition-oriented products in the late stages of applied research and advanced technology development. FNCs provide enabling capabilities to fill gaps in Department of Navy acquisition efforts.

– Leap-Ahead Innovations ($203 million) "Innovative Naval Prototypes" and "Swamp Works" projects comprise the bulk of this S&T investment. These are technology investments that are potentially "game changing" or "disruptive" in nature.

The Department of the Navy's S&T investment also supports the High Integrity GPS program ($63 million), a project that has the potential to be truly revolutionary for all Components. This project is funded in the Common Picture Advanced Technology.

Air Force S&T Request
(President's Budget – Total Obligation Authority)

Then Year Dollars (in millions)	FY 2008 Request	FY 2009 Request
Basic Research	375	452
Applied Research	1,011	1,044
Advanced Technology Development	577	578
Total Air Force Science and Technology	**1,964**	**2,075**

The Air Force has refined the focus of their S&T program to anticipate, find, fix, track, engage, assess – anything, anytime, anywhere. Highlights of the FY 2009 Air Force budget request include:

– Foundational Sciences ($442 million) This investment is comprised of basic research. Increased investment in fundamental basic research to include the University Research Initiative with emphasis in the areas to defeat speed of light weapons, information warfare/information assurance (quantum computing/encryption), networking, improved decision making technology, autonomous systems (bio-inspired, swarming, etc.,) and nanotechnology/nanosensors.

– Weapon Systems ($208 million) – Increased emphasis in offensive and defensive Directed Energy S&T, including eye safety and thermal management technology, and solid state lasers and high power microwaves that could enable speed of light attack with extremely high precision and minimal collateral damage. The AF also continues to develop advanced conventional weapons.

– Anticipate, Protect Against, and Track Enemy Actions ($435 million) – Increased emphasis in areas to better anticipate, protect against, and track enemy actions, anywhere, anytime, to include decision making tools and techniques that understand political, military, economic, social, information, and infrastructure relationships, offensive and defensive cyber operations, and multi-layered sensing architectures providing persistent intelligence, surveillance, and reconnaissance capabilities.

– Space ($223 million) – Increased emphasis in Space S&T in the areas of Space Situational Awareness and Defensive Counter Space could enable better awareness of potential spacecraft threats and protection from those threats.

– Propulsion, Structures and Energy ($557 million) – Increased emphasis in revolutionary propulsion S&T in the area of Adaptive Versatile Engine Technology (ADVENT) that could enable development of energy efficient, multi-design point engines pervasive to multiple aircraft platforms. The Air Force also increased emphasis in the area of aircraft power and thermal management, addressing operational limitation concerns about the growing thermal load on fielded and pipeline aircraft.

– Materials and Manufacturing ($199 million) – Increased emphasis in metamaterials technology development, addressed an industrial base issue involving Lithium Ion batteries, and realigned Manufacturing Technology (ManTech) into the S&T portfolio. The AF ManTech program is now better focused on generic and pervasive long-term manufacturing technologies and near-term processes with the main objectives to reduce costs in acquisition and sustainment systems, reduce cycle and delivery times, and reduce risk to fielding of new capabilities.

DARPA S&T Request

(President's Budget – Total Obligation Authority)

Then Year Dollars (in millions)	FY 2008 Request	FY 2009 Request
Basic Research	153	196
Applied Research	1,403	1,334
Advanced Technology Development	1,477	1,625
Total DARPA Science and Technology	**3,033**	**3,155**

The FY 2009 budget requests $3.2 billion to continue DARPA's basic, applied, and advanced technology programs. Basic Research is funded at $196 million in FY 2009 to continue projects in biology, electronics, materials and information sciences. DARPA will continue investments in Space ($417 million); Networks ($317 million); manned and unmanned ground, sea, and air Advanced Platforms ($421 million); and Cognitive Computing Systems ($146 million). DARPA also is continuing investment in hypersonics through the new Blackswift program which is jointly funded by the Air Force. DARPA also is expanding support to the President's Comprehensive National Cyber Security Initiative through an increased investment of $50 million.

DTRA S&T Request

(President's Budget – Total Obligation Authority)

Then Year Dollars (in millions)	FY 2008 Request	FY 2009 Request
Basic Research	5	18
Applied Research	182	211
Advanced Technology Development	213	211
Total DTRA Science and Technology	**401**	**440**

The Defense Threat Reduction Agency's (DTRA) Basic Research Program is conducting research to benefit WMD-related defense missions and improve Agency knowledge of other research efforts of potential benefit to DTRA non-proliferation, counter-proliferation and consequence management efforts. To complement the basic research, DTRA has taken steps within its Applied Research budget activity to develop a strong threat reduction technology base and provide a foundation for transformational activities within the counter-WMD arena through enhanced efforts within its Detection Technology, Advanced Energetics & Counter WMD Weapons, Nuclear & Radiological Effects programs.

- Detection Technology – Enables the detection, identification, tracking, tagging, location, monitoring and interdiction of nuclear and radiological weapons, components or materials.

- Nuclear Forensics - Develop and implement an accurate, rapid and reliable global capability to collect/analyze post-detonation prompt data and ground debris from a nuclear or radiological event.

- Advanced Energetics & Counter WMD Weapons – Enables the development and/or maturing of technologies supporting defeat of WMD targets (including facilities with chemical, biological, or nuclear (CBN) agents) while minimizing collateral damage and release of those

agents when using air, land and sea assets brought to the theater by the warfighters.

– Nuclear & Radiological Effects – Enable the development of nuclear and radiological assessment modeling tools and the conduct of various analyses support and/or development efforts.

DTRA continues its efforts in restructuring its Advanced Technology Development investment portfolio to support the Quadrennial Defense Review Transformational Goals and to better align its portfolio with requirements and initiatives supporting combating WMD. Increased emphasis is occurring within the Counter-terrorism Technologies, Detection Technology, and Target Assessment Technologies programs.

– Counter-terrorism Technologies – Enables (1) the identification, defeat, containment, and mitigation of WMD-capable IEDs; and (2) Special Operation Forces (SOF) capabilities to detect, interdict, neutralize and destroy CBN production, storage and weaponization facilities.

– Target Assessment Technologies – Provides enabling technology for the Intelligence Community and COCOMS to find and characterize WMD targets, including those protected in hard and deeply buried facilities, to support full dimensional defeat operations.

EMERGENT AND NON-KINETIC PROGRAM INCREASES – DDR&E FOCUS AREAS

The FY 2009 S&T request continues the realignment to address new and emerging capabilities outlined in the 2006 QDR. The DoD began this realignment in FY 2008 and over the past two years has realigned roughly $3 billion in S&T investment planned over the future year defense program. Most, but not all of these increases were made to the Office of the Secretary of Defense programs. These realignments resulted in both new FY 2008 start programs and enhancements to existing programs. Highlights of some of the more significant of these efforts follow:

Biometrics S&T. The Department continues to increase the investment, in Biometrics S&T, following the program initiation in FY 2008. The biometrics office is working to advance capabilities to identify anonymous individuals using biometric markers, such as fingerprints, DNA, and so forth. The focus of the biometrics program seeks to improve the quality of biometrically derived information for the purpose of identifying and classifying individuals. It is vital that unknown persons be quickly and accurately characterized as “friend”,

"enemy" or "neutral" in all military environments to enable tactical, intelligence, and management decisions consistent with law, policy, and rules of engagement. The DoD Biometrics S&T program leverages heavily and co-develops the work in biometrics of other government agencies. By the end of 2009, the biometrics investment should deliver several key biometric products to include:

- DoD Biometrics Science and Technology Strategy and Roadmap
- Modeling tool for biometric systems architecture and decision support
- Prototypical biometric collection systems for demonstration and experimentation
- Prototypical forensic collection, processing, exploitation systems for demonstration and experimentation
- Data packages and white papers on standards and algorithm development

Human, Social and Culture Behavior Modeling. The Human, Social and Culture Behavior (HSCB) Modeling program is an integrated program that began in FY 2008, and continues with FY 2009 investment in specific programs in applied research, advanced technology development and advanced capability development and prototyping. The HSCB program seeks to develop and deliver models to help the US warfighters understand different cultures, social norms and behavioral responses. This collection of HSCB programs support all phases of military operations from full scale warfare to insurgency to security, stabilization, and reconstruction operations. The programs seek to develop software models and analytic approaches that provide insight and understanding for decision support programs of record, intelligence analysis tools and training simulation and gaming systems. The program will develop validated human terrain forecasting capabilities that can be generalized across user communities and can scale vertically from tactical to strategic levels.

The FY 2008 planned transitions from the program are an initial HSCB data model that seeks to support computational socio-cultural models that could be used in operational level planning. Initial cultural mapping capability will transition into the Distributed Common Ground Station - Army software and the delivery of a Pacific Command, Special Operations (SOCPAC) strategic planning tool. With the FY 2009 budget request, we anticipate up to six specific models, analysis or training products to be delivered in the fiscal year.

Persistent Wide-Area ISR. Over the past two years, the Office of the Director of Defense Research and Engineering (ODDR&E) has initiated several programs to accelerate the development and delivery of persistent surveillance. The first of these is the Synthetic Aperture Radar Coherent Change Detection (SAR CCD), which enables the tactical user to detect changes in terrain due to

human activity by comparing multiple Synthetic Aperture Radar (SAR) images of the same area—separated by time. Synthetic Aperture Radars are largely unaffected by clouds, and measure very accurately the surface height and smoothness of a feature. Disturbed ground has a different reflective signature than does undisturbed ground. Using this attribute, the SAR CCD capability enhances the warfighter's ability to conduct persistent surveillance relative to multiple missions including special operations, detection of movement across borders, over the horizon, troop/vehicle movement, construction activity, and natural disaster monitoring (volcanic activity, fault lines). The goal of the SAR CCD effort is to deliver this capability, in a package that could fit on a small UAV, to the end user for $500K per platform.

Current operations have demonstrated the need for a robust infrastructure to support intelligence, surveillance and reconnaissance (ISR), to include strengthening the data storage, transmission and analysis tool capabilities to deal with very large data sets. In 2007, the ODDR&E initiated project Bluegrass to collect large multi-sensor data sets (including Electro-Optical and radar) with ground truth. This data set is being made available to qualified users to support the development of data analysis tools. The ODDR&E is working with the Under Secretary of Defense for Intelligence and the Joint Persistent ISR office of National Geospatial Imagery Agency to develop a set of challenge problems based on Bluegrass exercise data. The challenge problem will help identify focus areas and enhance future capabilities. It is interesting to note the JASONs advisory group recommended in January 2008, that the DoD make use of this data set to address the challenge of handling very large data sets – work that the Department has already begun.

Currently, the Joint Capability Technology Demonstration office within DDR&E is rapidly prototyping several potential solutions that could be game changers in the area of persistent surveillance. The first is a liquid hydrogen powered UAV that can stay aloft for days to weeks and carry a large ISR payload. This demonstration will carry a potential payload to allow long duration persistent surveillance. The same office is also demonstrating a solar electric powered UAV for small payloads that have the potential to be airborne for a month or longer. Airship technology is also an attractive alternative and we are prototyping an unmanned airship that can station-keep to provide extended-dwell area surveillance. To support DoD Homeland Defense and Homeland Security, this office is examining approaches that will improve over-the–horizon (OTH) radars for long range maritime and air tracking.

Finally, the ODDR&E is prototyping the use of such new capabilities as hyper-spectral imagers to determine unique attributes of terrain. Some of these prototypes are being used to deliver products supporting the GWOT. For

example, this year, we organized a mission for the US State Department to map the natural resources of Afghanistan. This mission (referred to as Halo Falcon) was undertaken at the request of the Afghanistan Government, and used a prototype DoD Hyperspectral Sensor on the NASA owned WB-57 high altitude test aircraft. This project should permit the identification of natural resources and are important to the future economic well being of Afghanistan. These products are in the process of being delivered to the Afghanistan Government by the State Department.

Tagging, Tracking, and Locating. Tagging, tracking, and locating (TTL) is another important set capability enabled by a set of programs and functions sponsored by the ODDR&E, and is used in prosecuting the Global War on Terror. The U.S. Special Operations Command (USSOCOM) has placed TTL at the top of its priority list for technology enhancements, and the DDR&E, in cooperation with the Commander, USSOCOM has increased S&T funding in FY 2008 and the FY 2009 budget request.

The increased budget request for this capability has been placed in Program Elements at USSOCOM and in the US Army, with oversight by the USSOCOM Acquisition Executive and Deputy Under Secretary of Defense (Science and Technology). Nineteen new projects have been initiated in FY 2008 at all levels of S&T maturity. These projects emphasize technologies to reduce the size of tagging and tracking devices and to provide for new and better methods to deploy and monitor them. While much of the specifics of this work is classified, the potential near an far term pay off of this S&T effort to the GWOT is quite large.

Networks. In FY 2008, the ODDR&E started a new program in Networked Communications Capability. This program focuses on exploiting and improving the existing and planned DoD wireless communications networks used by our soldiers in Iraq, Afghanistan and around the world. The network program offers an example of the convergence of military and commercial technologies. While network technology is becoming ubiquitous in the commercial world, the demands of operating in regions without an existing mature infrastructure present unique challenges to the military. The DDR&E network program builds up from commercial products and applications to develop military unique high-end capabilities.

The DDR&E network program supplements the on-going research in the Components, and focuses on solving some of the most challenging problems in cross-Service wireless communications networking with a goal to seamlessly inter-network and operate the many diverse communications links that exist and will continue to exist in theater. This program directly addresses emerging problems the DoD has seen as a result of the Global War on Terror, such as our

soldiers out-running their communications in the race for Baghdad; the hundreds of operators needed in Joint and Service Network Operations Centers to operate and fight with our increasing complex networks; and the bandwidth bottlenecks in theater, which sometimes has left our ground commanders with the choice between jamming remotely triggered IEDs or communicating. This ODDR&E program is developing the joint tools needed to address these emerging needs and will transition products directly to the field and to major acquisition programs of record beginning in 2009.

Handling Large Datasets. As the Department increases our capability and capacity to generate large amounts of data from the numerous sensors in a battlespace, the issue of handling very large data sets is becoming more challenging. For instance, the Department S&T program recently developed and deployed a high resolution sensor on a UAV in a package called "Constant Hawk". This system allows capture and replay of data in a defined area. However, as the amount of data captured grows, so do the challenges of extracting the important pieces of information from the data. This is a multi-disciplinary challenge that makes use of increased throughput communication channels with software that can be used to process the data. But, in addition to the existing systems and experiments, ODDR&E is conducting a number of demonstration programs to address the challenges of handling large data sets.

Because of the complexity and scope of the issue, the ODDR&E established a "Technology Focus Team" in fall 2007 to review the current investment and programs across the entire Department. This review included members from the Services, DARPA, and the Intelligence Community. This team had a number of recommendations, the most pressing of which is to accelerate decision making tools—through the use of such tools, machines can assist the human in handling the large volume of data.

The Large Data Joint Capability Technology Demonstration (JCTD) is demonstrating the military utility of a highly scalable (up to exabytes), globally distributed, secure data framework to support the rapid movement of massive amounts of data. The Large Data JCTD integrates technologies and operational concepts to significantly improve warfighter situational awareness by enabling rapid access, integration and visualization of huge amounts of data as if it were on the desktop. The Large Data JCTD responds to an urgent need created by the exponential growth of sensor data from sensors now overwhelming the warfighters' ability to derive actionable information. This demonstration focuses on enabling warfighter access to globally-distributed large data via an advanced global enterprise storage network (petabytes over wide area networks) implemented with advanced search and visualization applications capitalizing on the new wideband infrastructure. The first limited military utility assessment for

Large Data was successfully conducted in November 2007, with an operational focus designed to accelerate analysts' access to very large, advanced geospatial intelligence (AGI) data to enhance analysis and indications and warning. Analysts were able to do in minutes what they normally do in hours; including specific technology applications to: download/move files, access different remote files; transfer theater ISR files and mirrored data to CONUS and Korea locations; and demonstrate the transfer of a total of ~2.2 terabytes of data simultaneously. Spiral transitions of new capability have already occurred within the intelligence community. These include (but were not limited to) a 10 Gigabit/second encryption to NSA, delivering a large data solution and design (to address sharing, storage and multi-site access of large wide area optical surveillance data) to Roadrunner for JIEDDO.

Cyber Protection. Another new focus area for the DoD comes in the area of cyber protection. Over the past decade, the Department has made the concept of net-enabled operations the cornerstone of our national defense posture. The underlying assumption of the DoD's strategic vision is the availability of a robust, reliable, secure information and communications infrastructure. The level of assurance, security, and protection needed requires fundamental advances in the science and engineering that underlies our cyber infrastructure. DoD potentially faces cyber adversaries that can devote significant resources to cyber operations. This threat is well beyond the target market for commercial cyber security development.

In FY 2008, the DoD reported $179 million in cyber security and information assurance S&T, with a similar investment expected in FY 2009. Most of this funding is in DARPA which leads the DoD cyber protection research. This year, ODDR&E is leading a Department-wide effort to address and focus S&T research for cyber protection – an effort that is well connected to the President's Comprehensive National Cybersecurity Initiative. Across the DoD, we are focusing our new research in three capability trends:

- Protect Data and Networks
- Secure Information Exchange
- Attack/Event Response

To significantly change the existing game of attack and defense, the DoD needs to begin research in leap-ahead technologies to fundamentally change the game. To date, protection has been applied after-the-fact. To secure cyberspace requires a fundamental redesign of both hardware and software technology, a redesign that will come largely through the S&T program. Technology advances are needed in the following areas, all of which are being addressed by the DoD.

- Adaptive and Resilient Systems
- Accountable information flow
- Secure system and software engineering
- Security Management Enterprise Health Monitoring
- Wireless Network and Mobile Device Security

Protection Capabilities. In FY 2009, the DoD increased our budget request for the long- term in the area of active and passive armor, in response to adaptive and emerging threats (large explosively formed penetrators, rocket propelled grenades & large under vehicle explosives). The budget request enhancement is being managed by the Army with funds added to the Army S&T program, but all ground forces should benefit. By 2011, the DoD should move from metals to composites in passive armor, focusing on cost reduction efforts. By 2013, in reactive armor, the DoD should have enhanced multi-threat protection with a potential for a 20 percent weight reduction over passive armor solutions. Finally, by 2017, the program should deliver advanced passive electro-magnetic armor providing enhanced protection against multiple threats, weight reduction, and adaptable to threat changes.

The Marine Corps also added $30 million in the FY 2009 budget request to conduct focused technology demonstrations of ground force protection capabilities to demonstrate the fusion of various sensors with existing technologies to provide enhanced decision systems to better protect dismounted ground troops.

In addition to the enhanced budget request for armor protection in the Army program, the DoD Foreign Comparative Technology (FCT) program has sought potential solutions from our allies. For instance, the need for a lighter weight, corrosion-resistant material for armor protection resulted in testing of AA5059 armor produced by a German company, Corus. This material was initially intended for use as an improved repair material for M2 Bradley Infantry Fighting Vehicles with battle damage or cracking of the existing armor plate. Subsequent testing under the FCT program provided the data needed to justify risk reduction and insertion of this new armor material in support of BAE System's Mine Resistant Ambush Protection (MRAP) as a spall liner. This material is on contract for procurement through 2008. Transition is being assessed for use in the Future Combat System and Joint Light Tactical Vehicle.

Metamaterials. In the FY 2009 budget request, the ODDR&E worked with the Air Force to create a new project in metamaterials. Meta-materials have certain characteristics that can reduce the visibility of objects to either optical or radar systems. The theoretical importance and existence of Metamaterials have been progressing in foreign scientific literature since the late 1960's. However,

worldwide Metamaterials research has grown rapidly since 2000 when the first negative index of refraction materials were demonstrated in Germany.

China, and a few other nations, have exponentially increased research in the past few years. In 2005 published over 250 papers in the open source literature after publishing fewer than 50 papers in previous years. A similar number were published in 2006. Additionally, the Chinese papers indicate maturing to the experimental phase. The two main application areas appear to be low observability and lightweight radar. This is a potentially "disruptive technology" area that the Department has determined requires increased attention, and has subsequently led to new start DoD projects. To accelerate the U.S program in this emerging technology area, the department has responded with applied research funding starting in FY 2009 of $15 million ramping to a sustained level of $25 million/year by 2011. The objective here will be to increase understanding of this new class of materials, demonstrate experimental methods leading to potential metamaterial structures and use metamaterials for small lightweight radars.

Energy Management. In summer 2006, in response to the growing impact the rising cost of energy has on the Department of Defense, the ODDR&E formed and led an Energy Security Task Force that encompassed all functions with the Department of Defense. As a result of the first phase of that Task Force, the Department started a number of S&T (and other type) of projects to enhance energy efficiency of platforms and installations, as well as address fuel availability. The Deputy Secretary has maintained improving energy efficiency as one of his top 25 goals. Among the S&T projects started were the following:

- The Highly Efficient Embedded Turbine Engine (HEETE), being conducted by the Air Force, is intended to develop core engine technology that could reduce fuel consumption in turbine engines by 25 percent. The Air Force is developing a high-pressure ratio, high temperature core technology. Funding in FY 2008 and 2009 is focused on the highest technical risk element – the high pressure compressor component development. This technology will support all ongoing turbine engine programs.The Small Heavy Fueled Engine demonstration also led by the Air Force, is a follow on demonstration of DARPA developed technology to use heavy fuel (standard diesel) to operate a small engine. With modern compression technology, we anticipate the potential to increase fuel efficiency and power density by 20 percent for unmanned aerial vehicles (UAVs) and generators and enable them to operate on fuels such as JP-8, to reduce the number of battlefield fuels.

- The Army is leading the “Fuel Efficiency Ground Vehicle Demonstrator”, or FED, which is designed to test various potentially high-payoff fuel

efficient technologies and advanced lightweight materials in innovative designs for medium tactical vehicles. We estimate these technologies could have a potential fuel savings of 30-40 percent, without sacrificing performance or capability, and a request for proposals will be released shortly. Over 40 bidders have responded to the initial request for information call.

- The Army's Rapid Equipping Force tested a transportable hybrid electric power stations (THEPS), using a combination of wind and solar energy with batteries and a generator. Field testing at the National Training Center (NTC) at Fort Irwin, California showed a need for modifications and additional hardening before being sent to forward deployed forces. The modified generators demonstrated over 90 percent savings in fuel use at low- to mid-level loads and 30 percent at high loads. A procurement decision is expected this month to expand the program.

- THEPS' concept of improving power generation and storage led to the Army's Hybrid Intelligent Power Sources (HI-POWER) program. HI-POWER is taking a holistic approach to generator power generation, management and storage through intelligent power distribution. For instance, if more power is being generated than is required, the smart system will automatically shut down some generators, thereby saving fuel. Models have predicted a 40 percent reduction in fuel consumption. A request for proposals was issued in December 2007, and multiple awards are anticipated in March 2008.

- The Navy has the lead for developing and demonstrating a family of compact and mobile high temperature fuel cell systems to power critical equipment, including GPS, radio and communications equipment, computers, intelligence, surveillance and reconnaissance gear, laser designators, and aviation ground and flight applications. These systems provide silent, portable power and eliminate dependence on large generator or grid power for battery charging. Fuel cells are highly efficient (about 55 percent) and will run on jet fuel, like JP-5 and JP-8. Fuel cells also provide a better power source in terms of weight and available energy to the soldier and auxiliary power applications for vehicles for missions over 24 hours.

DEPARTMENT OF DEFENSE BASIC RESEARCH ENHANCEMENT

Underpinning and central to the Department's FY 2009 budget request, and the push to address emerging technology areas is an increase to the Basic Research accounts of the Components. In FY 2009, the Secretary of Defense is seeking the

Congress to approve a $1.7 billion investment in Basic Research in the President's Budget Request. The request represents a 2% real increase above the $1.6 billion that the Congress appropriated for FY 2008 and a 16% increase in real terms over the Department's FY 2008 budget request for Basic Research.

The Secretary of Defense personally directed the FY 2009 budget request increase. The decision to increase the budget request for Basic Research is an important strategic decision, not taken lightly. DoD has many short-term needs against which to invest its resources. The fact that the Secretary explicitly decided, in a difficult budgetary environment, to give priority to an increased Basic Research investment indicates how critically the Department views the need to address the longer-term national defense posture. The table below shows the total funding for Basic Research in the FY 2008 President's Budget Request, the FY 2008 Appropriations, and the FY 2009 President's Budget Request, including the actual and percentage increases above zero percent real growth. All of those funds will be invested in peer-reviewed, merit-based research projects.

$M	FY08 PBR	FY08 Appropriation	FY09 PBR	Change from PBR08	Real Change from PBR08
Army	306	381	379	24.1%	21.4%
Navy	467	506	528	13.1%	10.6%
Air Force	375	408	452	20.6%	17.9%
Defense-Wide	280	338	339	21.0%	18.4%
Total Basic Research	1,428	1,634	1,699	18.9%	16.4%

The Department's investment in Basic Research has been roughly constant in real terms for more than a quarter century. The President's Budget Request reflects the position that increased investment is needed to generate new knowledge to address the greater number of diverse, rapidly evolving threats, as outlined in the QDR.

The increased budget request in Basic Research funding will be concentrated in academic disciplines that contribute to the following emerging science areas:

- Information Assurance
- Network Sciences
- Counter WMD
- Science of Autonomy
- Information Fusion & Decision Science
- Biosensors and Bio-inspired Systems

- Quantum Information Sciences
- Energy and Power Management
- Counter Directed Energy Weapons
- Immersive Science for Training & Mission Rehearsal
- Human Sciences

The funds in the President's Budget Request are allocated to the Services, Defense Advanced Research Projects Agency, and Defense Threat Reduction Agency. These funds will primarily be used to support faculty in universities for periods of up to five years each and will provide sufficient funds to permit the operation of a focused research team, to include graduate students, in an area of interest to DoD. In any case, the proposed funding increases will be allocated to peer-reviewed research to enhance the discovery of new scientific breakthroughs that should lead to a continued flow of superior military capabilities well into the future.

PROGRESS IN OTHER OFFICE OF THE SECRETARY OF DEFENSE S&T PROGRAMS

While the ODDR&E focus areas have a certain emphasis, it is important to recognize the on-going successes of the existing programs within the DDR&E portfolio. We will highlight some selected recent successes below.

Over the past year, we have had two of the longer lasting programs within the ODDR&E portfolio, the Strategic Environmental Research and Development program and the High Performance Computer Modernization Office conduct a detailed return on investment analysis. Both programs are able to show a strong return on investment.

For example, the Strategic Environmental Research and Development Program (SERDP) has invested in technologies to allow the Department to operate and train in an environmentally responsible manner. Over the past decade, the long-term return on investment for this program has exceeded 8:1. The program continues to produce, since in the past year, they have sponsored development of the Berkeley Unexploded Ordnance Discriminator (BUD). BUD is an electromagnetic system that can determine the location, size, and shape of subsurface metallic objects from a single measurement in just a few seconds, allowing for real-time discrimination of hazardous unexploded ordnance from scrap metal. Through its increased speed and accuracy, BUD has the potential to greatly reduce the time and cost of remediating munitions-impacted sites, and may also play a role in detection of buried improvised explosive devices. In recognition of its breakthrough capabilities, BUD was winner of a prestigious

2007 R&D 100 award. BUD is currently undergoing testing at multiple sites under Environmental Security Technology Certification Program (ESTCP). Its performance to date has surpassed all expectations and should significantly decrease costs of cleanup and improve the quality as well. This data will establish its performance capability and be used to convince regulators. In addition, ESTCP has a related demonstration project with a commercial sensor company who is testing variations of the BUD design for commercialization.

The High Performance Computing Modernization Program (HPCMP) has produced a large ROI, nearing 10:1 in supporting diverse areas such as acquisition modeling and weather and oceanographic forecasting. A recent S&T advance by the Department's HPCMP entails development and improvement of the Navy's global Numerical Weather Prediction (NWP) model, which is one of the world's best predictors of tropical cyclone tracks. Cyclones and hurricanes obviously have a major adverse impact on military and civilian activities. The practical impact of NWP is that the projected coastal landfall width of approaching tropical storms has been reduced from 460 miles down to 120 miles over the past several decades. This reduction has a huge positive impact in limiting unnecessary evacuations of civilian population and military assets.

To address the Department's ever-increasing dependence on complex software in military platforms and systems, DoD supports S&T investments at the Software Engineering Institute (SEI), a Federally Funded Research and Development Center (FFRDC), to advance the state-of-the-art in software technology, and to transition those advances into DoD programs. For 20 years, DoD's software S&T efforts through SEI have yielded a steady stream of technologies, such as Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI), that represent the international gold standard for software development practices. Recent S&T advances in CMMI for Acquisition (CMMI-A), software product lines, and Architecture Tradeoff Analysis Method (ATAM) are already making a significant positive impact in reduced schedule and cost in numerous DoD acquisition programs.

The ODDR&E program also invests in another FFRDC, MIT Lincoln Lab. Lincoln Lab specializes in developing communications and information technology, advanced electronics, sensors, and integrated systems for air and missile defense. Lincoln's long-term interaction with the Missile Defense Agency resulted in the development and testing of technologies that were involved in the recent successful shoot down of the United States satellite by the Missile Defense Agency. Additionally, in the past year, the Lincoln Lab has developed and deployed an integrated prototype system that allows detection of chemical and biological agents rapidly and at low concentrations. This is a specialty system, not

developed for commercialization, but it does demonstrate the potential of managing sensors and information systems in an integrated fashion.

The Joint Capability Technology Demonstration (JCTD) Program has had many remarkable successes in its first couple years replacing the ACTD Program. The JCTD Program currently has over 40 different ACTDs and JCTDs deploying prototypes to aid in the Global War On Terror as well as Operations IRAQI and ENDURING FREEDOM and has a transition rate of approximately 80% to enduring capabilities. The Mapping the Human Terrain (MAP-HT) JCTD in its first year deployed over 20 Human Terrain Teams (HTTS) to OIF & OEF. These teams have deployed an integrated, open source, human terrain data collection and visualization toolkit to support Brigade Combat teams in understanding human terrain. Prior to deployment of the MAP-HT toolkit, combat teams had severely limited Joint, Service, or Interagency integrated capability (organization, methods, tools) to effectively collect/consolidate, visualize, and understand open source socio-cultural ("green data") information to assist Commanders understand the "human terrain" in which they operate. The MAP-HT toolkit is increasing team situational awareness and enhancing interoperability with Iraqi troops and civilian leadership while improving security.

An Advanced Concept Technology Demonstration called the "Joint Precision Airdrop System" has enabled high flying aircraft to accurately parachute cargo into pre-planned drop zones. Previously, parachute resupply was problematic. Planes making the drop at low altitudes risked ground fire. At higher altitudes, winds often caused parachute loads to drift great distances away from drop zones. The JPADS ACTD developed streamlined airdrop request and control procedures resulting in facilitated delivery and reduced vulnerability and exposure to frontline troops in OEF. Since July 2006, this capability has enabled over 500 combat airdrops to more than 25 remote bases in theater, totaling over six million pounds of supplies. In October 2007, the largest single drop in one day was made to one forward base, providing over 85,000 pounds of supplies, and enough support for the winter. In several cases, these drops gave U.S. warfighters a tactical edge, providing them with ammunition and fuel to execute the fight and saving lives. Additionally, it's estimated these drops eliminated the need for over 270 ground convoys - about 2,700 vehicles and 6,200 personnel - or more than 1,000 helicopter resupply missions."

The Quick Reaction Special Projects program has three separate projects to accelerate moving technology into the hands of the warfighter. The three elements are the Rapid Reaction Fund, which primarily supports research and technology development for insurgency operations; the Quick Reaction Fund, which demonstrates technology capabilities for conventional and disruptive applications within a 12 month time frame; and the technology transition program, which seeks

to move capabilities from any source into a program of record. Each of these projects has delivered successful projects. A few examples are:

Advanced Prototype Development Effort, Test & Evaluation XPAK (Explosives Particulate Analysis Kit), a system developed under the RRF to detect trace explosives and provide the warfighter with a rugged, portable system that quickly identifies traces of any of the three major classes explosives from personnel and surfaces. XPAK has shown excellent performance in a compact, robust, and low cost package. These units are currently deployed with DoD weapons intelligence teams in theater.

Human Terrain Information System project is another RRF project that provides unit commanders, their staffs and combat forces with the knowledge, training and tools needed to rapidly understand and exploit foreign cultures so that this understanding can be applied to enhance situational awareness. Since this project started interest has been high and the capability has been the foundation for, and transitioned to deployed Human Terrain Teams. These teams include anthropologists and have gathered significant media interest.

The QRF funded the development, test, and deployment of an inflatable ground SATCOM terminal, called "GATOR"; the S&T came in the application of new lightweight materials and design that allowed the antenna to be deflated and carried in a suitcase, but still allow for high-bandwidth throughput. This design replaced a heavy hard rigid antenna with something that is one-man portable. The system was tested with great success in humanitarian relief efforts by USSOCOM and during the 2007 deployment of USNS Comfort to Latin America, and is currently being procured under a contract through USOCOM. The system moved from design to test to field in under a year.

The QRF also funded a methanol fuel cell demonstration to develop and demonstrate a ruggedized fuel cell for use by dismounted industry. The company that demonstrated this fuel cell, called "Protonex", delivered a field battery charger in under 12-months, and did this in conjunction with the Army. The battery recharger is a 250 watts methanol fueled power source that over the course of a 72 hour mission can save 90% on cost and 30% on weight over using non-rechargeable batteries. It also has the potential to be used as a silent auxiliary power unit for use in mid-range power applications or by dismounted units.

The Command Post of the Future and Army Battle Command System (ABCS) Server Software Integration is a technology transition effort that provides a common commander’s executive collaboration mechanism and integrates it with existing ABCS systems, significantly reducing units’ logistical footprint. The

initial transition to PM Battle Command to be followed by transition to Joint Common Tactical Workstation.

The Defense Acquisition Challenge (DAC) and Foreign Comparative Testing (FCT) Programs focus on near-term transition to operations and warfighter needs, testing innovative, yet mature technology and equipment for insertion into acquisition programs. For DAC, since 2003, 28 projects met testing requirements, 23 resulted in procurements, 16 which have been fielded in direct support of the GWOT. Since program inception in 1980, FCT has invested over $1 billion for the testing of coalition equipment or technology, resulting in over $8 billion of capability fielded in support of warfighting operations. Significant for DoD and taxpayers is the estimated return-on-investment of 9:1 for DAC and 7:1 for FCT

A couple of examples make the value of DAC and FCT more concrete. One of the most touted successes of the S&T program in recent years has been the "Angel Fire" capability. DAC funded the transition and suitability work for Angel Fire program. Started by the Air Force Research Laboratory and the Air Force Institute of Technology, Angel Fire brings near-real-time, wide-area, persistent surveillance to a Ramadi-sized city using an airborne platform and a Google-Earth interface. It boasts the resolution to track both people and vehicles. With the cooperation of 11 DoD organizations and a full-court press by the Marine Corp, Angel Fire deployed to the theater last year and supports currently supports daily operations. The Marine Corp has four systems now and has funded another four for delivery in FY 2008. DAC is currently sponsoring a follow-on project to add night and spot zoom capability to Angel Fire.

The FCT program has also delivered. The Marine Corp has been aggressively upgrading their M1A1 tanks based on their ongoing experience in Iraq. The German optics maker Zeiss completed an Eyesafe Laser Rangefinder for the Marines, which not only met the eye safe requirements but also increased the effective range by 2,000 meters. This has been deployed in large numbers, with 472 units purchased to date for $13.5 million and installed as a drop-in replacement for the older range finder.

The Biocular Image Control Unit made by Brimar, Ltd, in the United Kingdom supports the USMC M1A1 Firepower Enhancement Program. This unit enhances a tank crew's situational awareness by enabling the 2nd generation Forward Look Infrared imagery to be displayed in both the Gunner's primary sight monocular display and also the biocular display. These units started deploying to Marine Corp M1A1s soon after testing completed.

The Defense Technology Transfer program provides a departmental capability to transfer its technologies to U.S. companies who productize them for

both military and commercial applications. The program funds efforts to facilitate Defense lab/industry collaborative R&D with companies that are often not traditional Defense R&D performers. It facilitates licensing of DoD patents. And, a DoD-wide Intellectual Property Management Information System (IPMIS) was developed and initial deployment is underway to assist DoD with leveraging DoD technology investments. As an example, TechLink facilitated a patent license agreement of a Navy developed perimeter security and surveillance system to a commercial partner for integration into their geographic information system product to pinpoint location and interpretation of remotely located acoustic events such as human or animal movement or movement of airborne or ground based vehicles. The technology offers great promise for activities such as remote border security or protection of critical infrastructure.

EDUCATING THE WORKFORCE

The final aspect to the continued reshaping of the DoD S&T program involves people. The DoD, like much of the government, currently has a science and engineering workforce that is aging. When adding in the emergence of new capability areas and the shift in underpinning science, the demands on educating and attracting the future workforce is difficult. Last year the National Academy of Sciences published a report entitled, "Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future." When the report was commissioned by Members of Congress, they asked the National Academy what actions federal policymakers could take to enhance America's science and technology enterprise in light of the global competition in the 21st century. The report presented four recommendations:

(1) Increase America's talent pool by improving K-12 math and science education,

(2) Sustain and strengthen the nation's commitment to long-term basic research,

(3) Develop, recruit and retain top students, scientists, and engineers from both the U.S. and abroad and,

(4) Ensure that the U.S. is the premier place in the world for innovation.

The DoD S&T community is deeply involved in, if not leading, each of these four areas. Under the National Defense Education Program, the Department has taken steps to address each area. The DoD is working through a pre-engineering partnership project to enhance science and math programs in K-12. This project has spanned schools in more than 13 states (growing to 20 states by 2010) and reached out to over 31,000 students and their teachers. Along with our science and engineering enrichment programs for middle and high school students,

we have partnered with college and graduate students to further their education in science, technology and engineering.

In S&E education, the DoD has two projects that are specifically targeting university students and researchers for the DoD. Our programs like SMART, (Science, Mathematics and Research for Transformation) scholarships are effective in engaging intelligent, motivated young people and helping them excel in these critical disciplines. Currently 29 graduates have entered the DoD workforce from SMART scholarships, 134 students are now in school supported by SMART, and more than 100 new SMART scholars will receive awards in FY 2008. Responding directly to the Academy's recommendation, this year DoD will award up to ten National Security Science and Engineering Faculty (NSSEFF) Fellowships that will attract the best physical scientists and engineers in academia to work on DoD's long-term basic research challenges.

SUMMARY

In closing, Mr. Chairman, I would once again like to thank the committee for the support of the Department of Defense Science and Technology program, and seek your continued support of the programs laid out in the FY 2009 President's Budget Request. The on-going emphasis of this Administration to the science and technology program is providing new capabilities for the men and women of our armed forces and revitalization of the Nation's S&E workforce, but the job is not done. Our armed forces deserve the best technologies and capabilities we can provide to them as we work together to expand the S&T program into new and exciting areas. With your help, the Department has been able to expand the Basic Research program signaling a strong commitment to deliver unimaginable capability to our armed forces well into this century. We seek your continued support for both the basic research expansion and the overall S&T program. With the continued support of Congress, the Department's S&T program will continue to deliver those superior capabilities our men and women in uniform deserve.